Some Energy Saving Technologies Proven, but Underused

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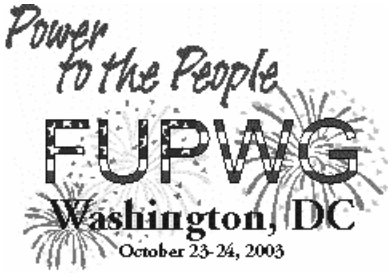
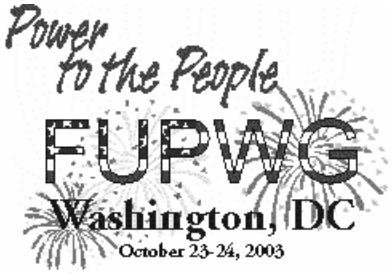
ERDC-CERL



Building Energy Systems

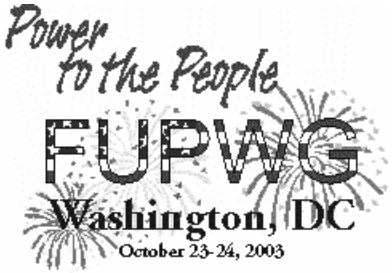
- Heating
- Cooling
- Ventilation
- Gas

- Compressed air
- Water supply
- Sewage
- Electricity



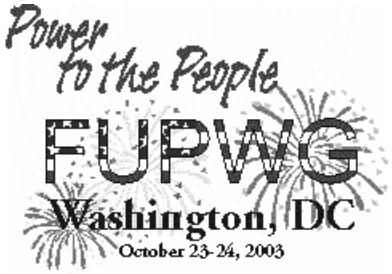
Energy Saving Technologies/ Measures

- Building envelope optimization
- Internal load reduction
- HVAC system related

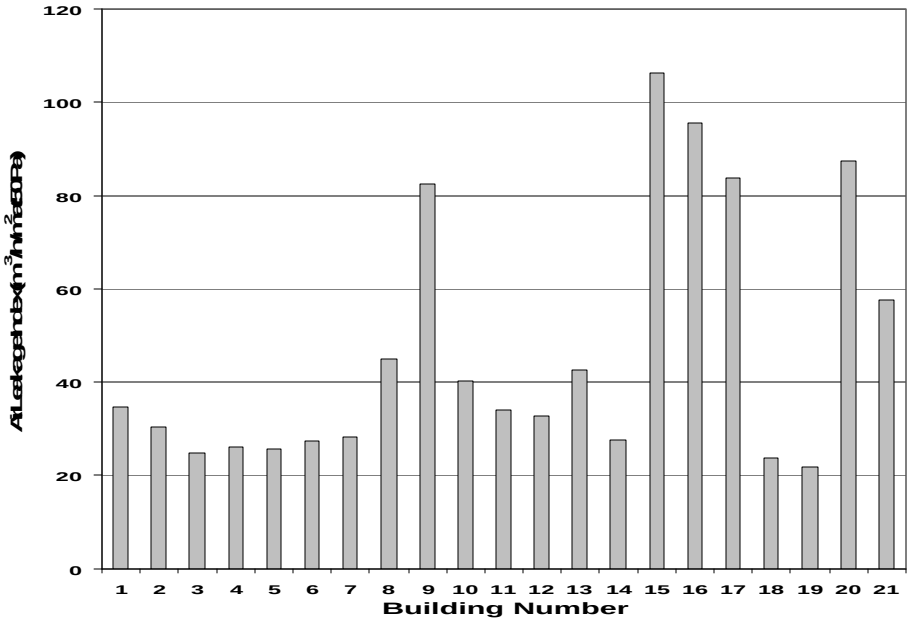


Some Building Related Measures

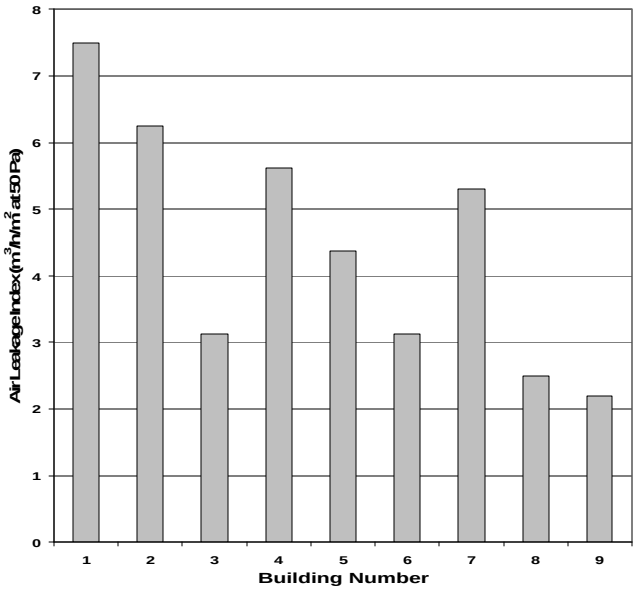
- Optimize the building envelope insulation for heat gains and losses
- Minimize exterior cracks/opening/gaps to reduce infiltration/exfiltration (e.g., by caulking, weather-stripping, vestibules, air curtains, etc)
- Consider insulated glass instead of a single-pane glass Consider tinted glass, reflective glass, coatings, awnings, overhangs, and shades for sunlight exterior windows



Energy Implications of Excessive Air Leakage

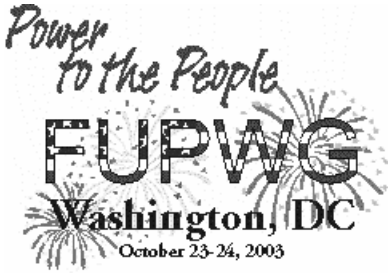


Air leakage indices of UK Industrial Buildings



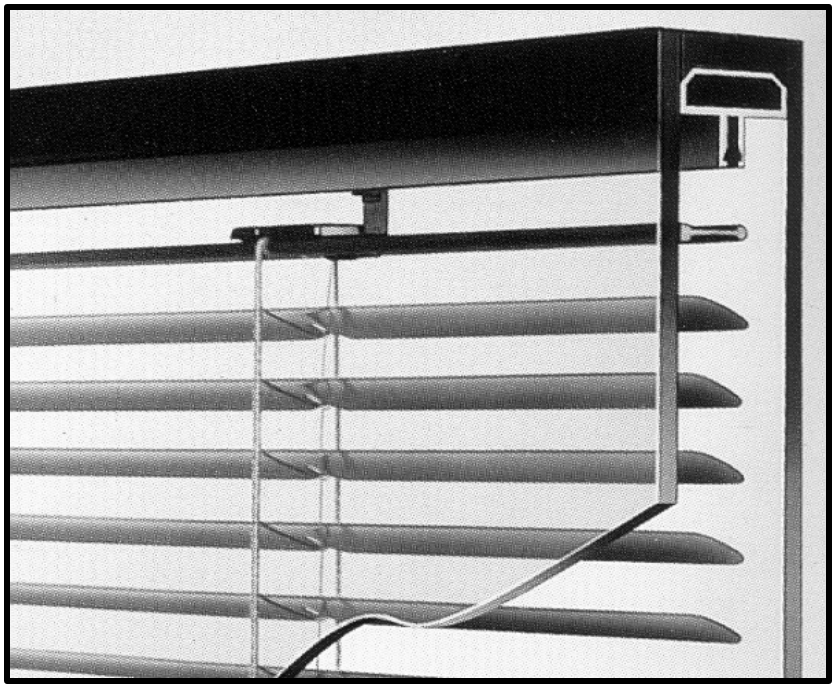
Air leakage indices of Swedish Industrial Buildings

According to BRE, potential annual energy savings for 10,000 m² industrial building due to an air leakage index reduction from 20 to 5 m³/h*m² at 50 Pa will be 165,000 kWh



External Shading

- Reduces cooling loads resulting from solar radiation
- Increases occupant thermal comfort
- Reduces glare



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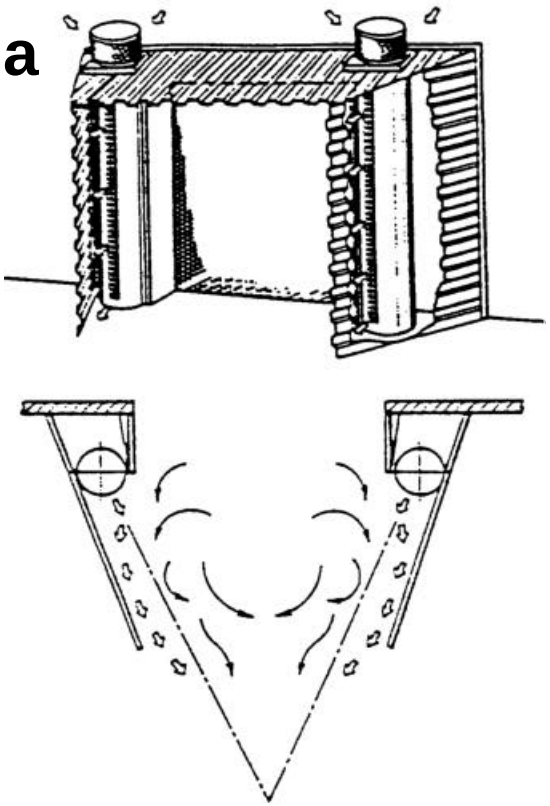
Air Curtains with a Lobby

a



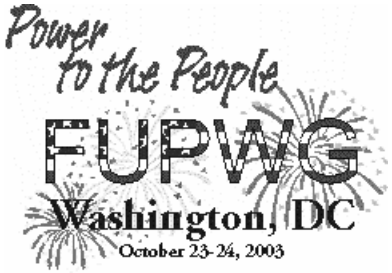
b

c

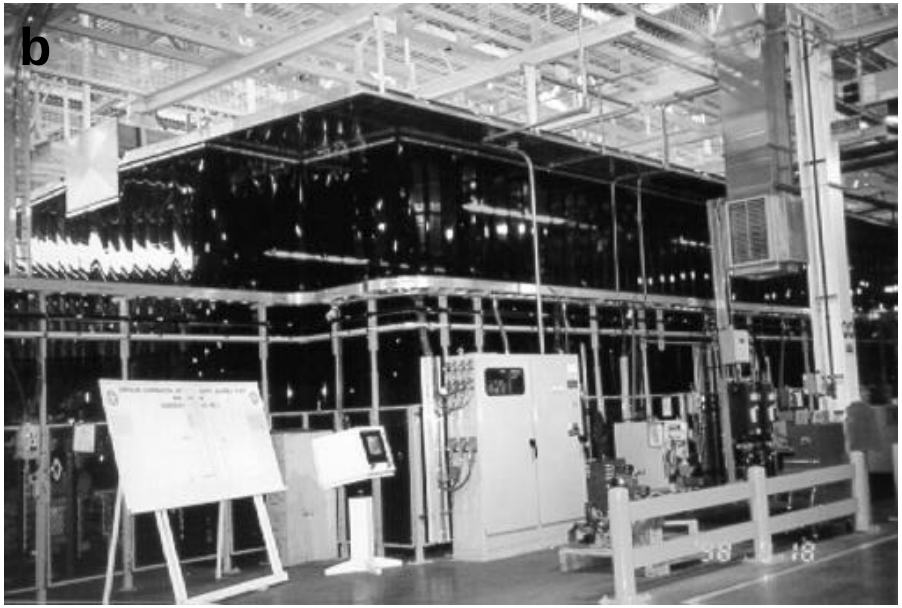
a - schematic
b - general view
c - air distribution duct with multiple nozzles

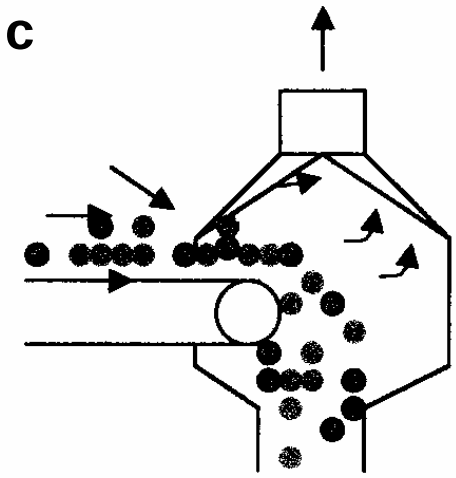
Examples of Internal Load Reduction

- Lighting
- Motion sensors
- EnergyStar appliances
- Process encapsulation, optimization and control



Process Encapsulation

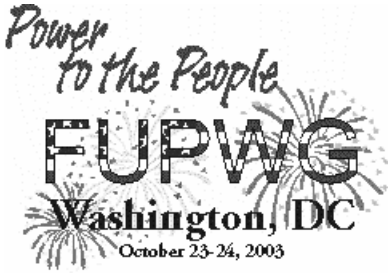




a - machining process enclosure with an oil mist control system ; **b** - canopy hood with a plastic curtain enclosing the robotic welding area; **c** - enclosed loading point from a conveyer belt (Reproduced from SSOE).

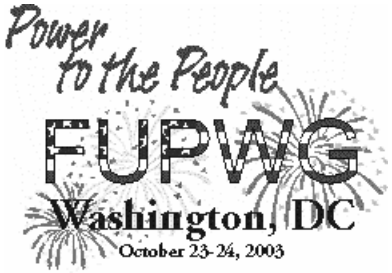
HVAC System Optimization

- Select HVAC concept allowing for high contaminant removal efficiency (better IAQ with lower ACH), higher heat load removal or higher heating effectiveness;
- Optimize HVAC operation modes throughout year-round cycle;
- Optimize system elements performance



Air Distribution Strategies for Thermal Comfort and IAQ Control

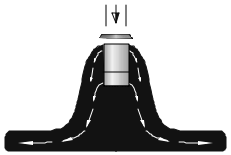
- Total room control
- Occupied zone control
- Workplace control

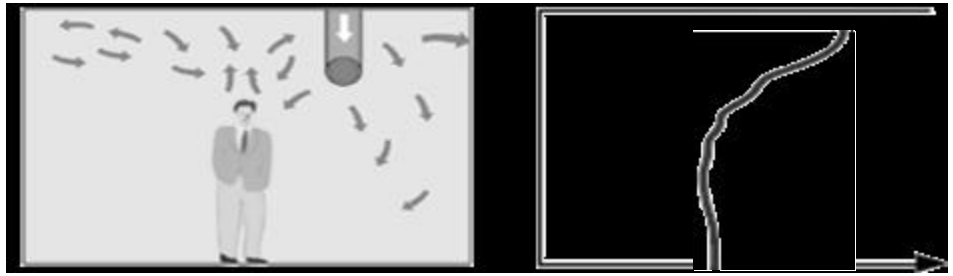


Occupied Zone Control

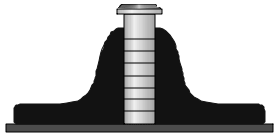
Mixed air distribution system

Displacement system with floor mounted air diffusers





Displacement system with air supply above the occupied zone



Individual Workplace Control

Task or personalized ventilation

Air supply to the workplace at the auto manufacturing plants

Air Change Efficiency between 1.4 and 2.7. Occupants/workers control local supply of air to adjust their individual thermal environment.

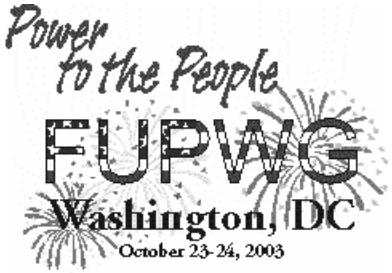
Hydronic Radiant Heating and Cooling Systems

Radiant Heating and Cooling systems allows for reduced room air temperature in heating mode and increased room air temperature in cooling mode with the same or better level of comfort, more uniform space heating and cooling, no noise and drafts. LCC is 25-30% better than with the forced air systems.

The 1903 Dana Building (Ann Arbor, Michigan) renovated in 2003.

Examples of HVAC System Related Measures

- Separate Ventilation and and HAC systems
- Hybrid ventilation
- VAV systems
- AHU process optimization
- BMS
- Use VFD for fans and pumps, when needed



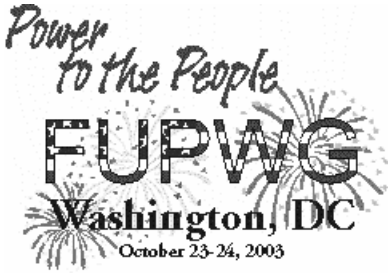
Equipment Efficiency

Problems (examples)

- Boiler: ~ 85% of energy is used to heat water, ~15% is lost with a flue gas
- Compressors: 85% of energy is lost with heat
- Cooling machines: the total amount of supplied electrical energy and absorbed heat can be utilized
- Pressure losses in air ducts due to poor duct design and not aerodynamic friendly duct elements

Solutions (examples)

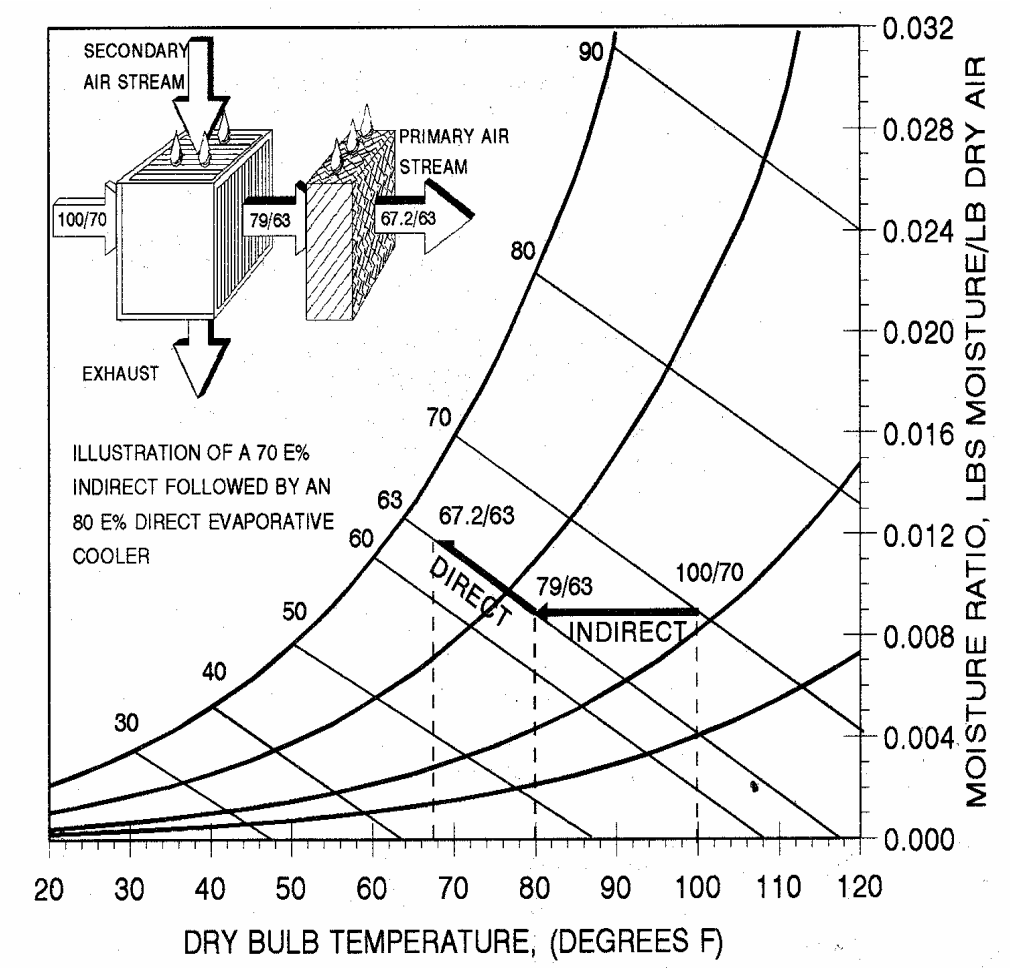
- Use high efficiency motors, chillers and furnaces
- Consider waste heat recovery, hybrid ground and air source heat pumps, etc.)
- Optimize duct design and select duct elements with lower pressure loss coefficients



Evaporative Cooling: Indirect/Direct Evaporative Cooling Cycle

An Indirect / Direct combination will provide cooler air than either process by itself.

In certain climates this combined process alone will provide true “comfort cooling”, or it can be used to reduce the size of a new chilled water system.



From the Leon Shapiro presentation (ADA Systems) at the Industry Workshop in Chicago, October 7-8, 2003

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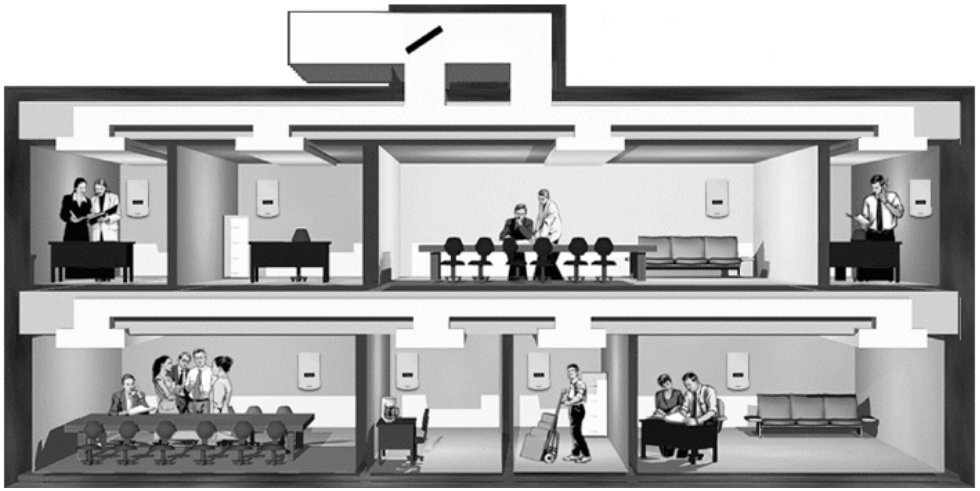
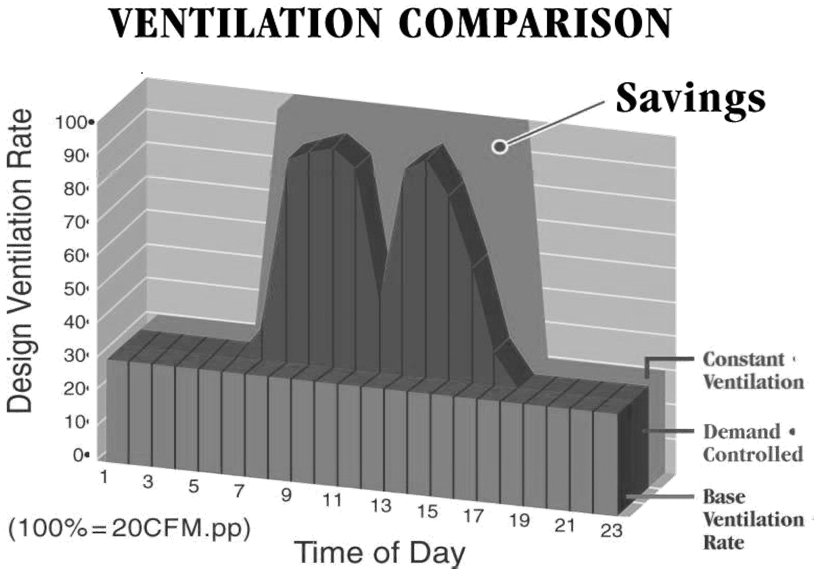
Demand Controlled Ventilation





- CO_2 sensors have become cost effective and reliable.
- Building control systems can now integrate zone ventilation control.

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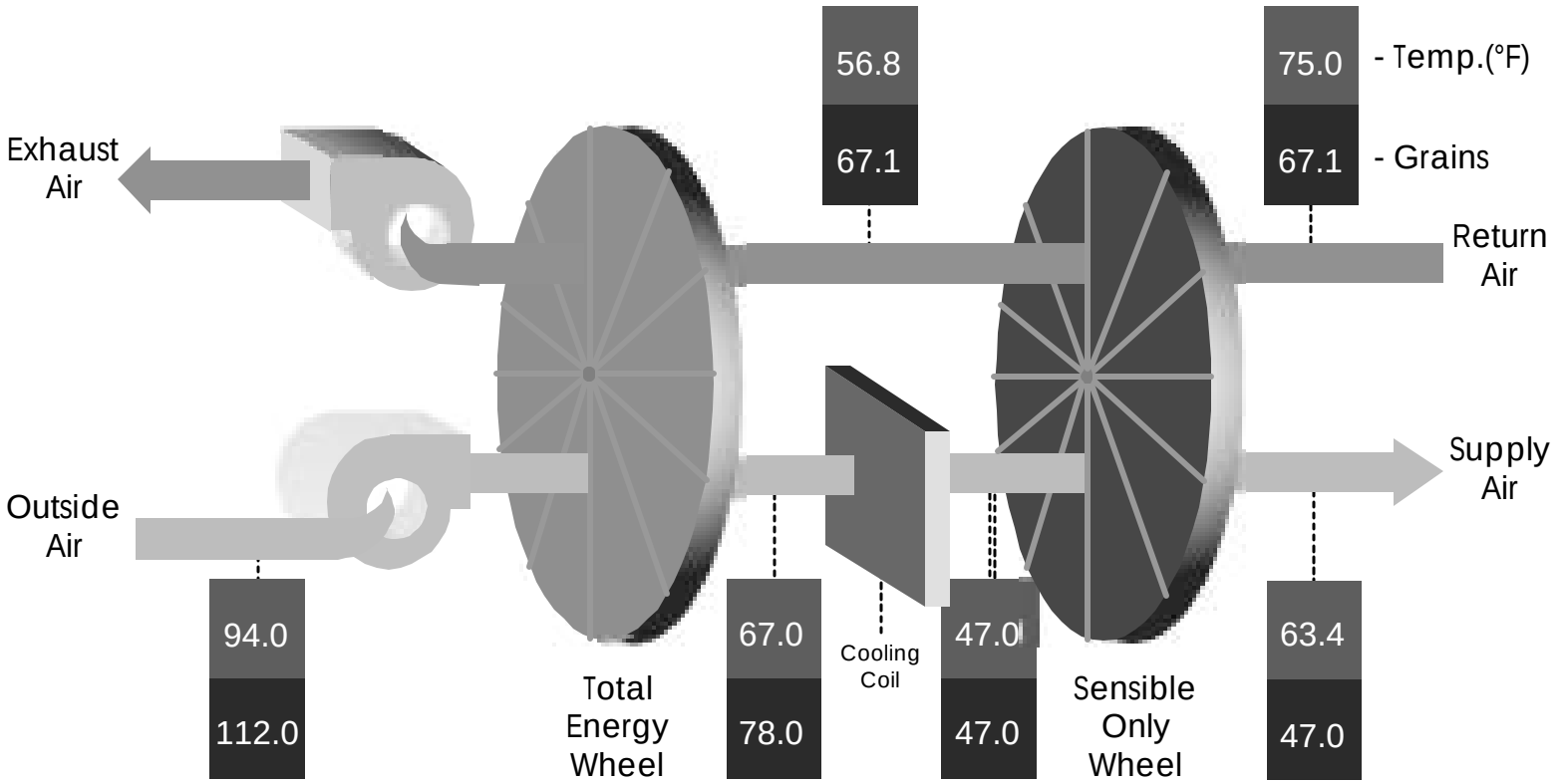
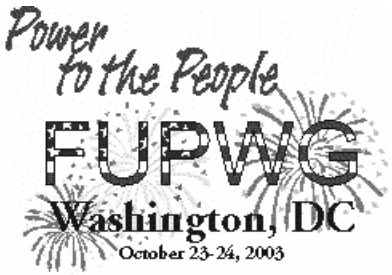
From the Richard Remke presentation (Carrier Corporation) at the Industry Workshop in Chicago, October 7-8, 2003

Energy Recovery from Exhaust Air





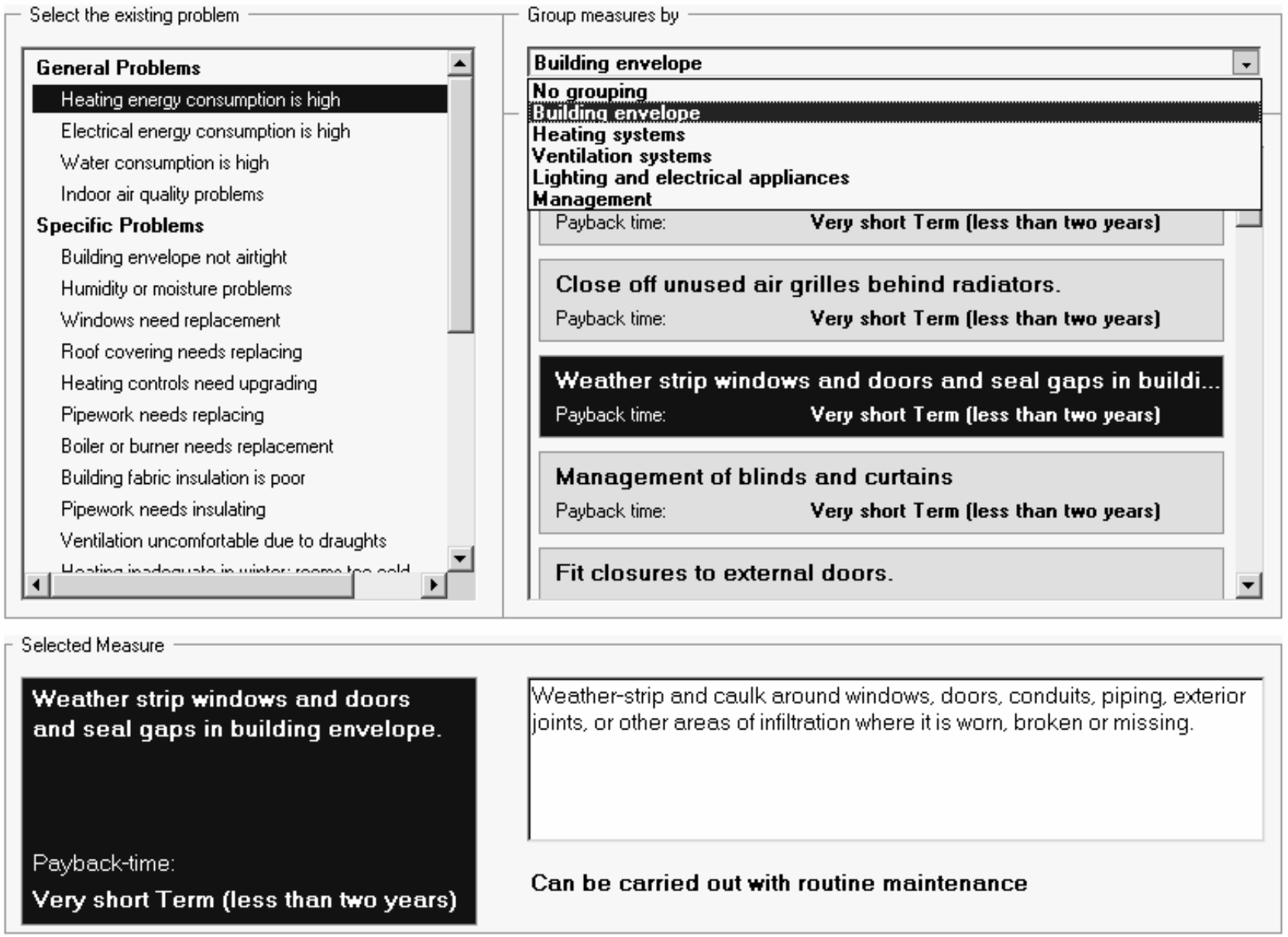
From the Doug Haas presentation (SEMCO) at the Industry Workshop in Chicago, October 7-8, 2003

Centralized VAV HVAC System with Energy Recovery from Production Shop with Machining Process

Roof-Top Air Handling Unit

Supply air bag filters and a heat recovery weal

Energy Concept Adviser



Conclusions

- Energy Efficiency should not be limited to installing a high efficiency boiler or alternative refrigerant chiller
- One can save more energy and money by avoiding the need for that boiler or chiller (or at least significantly downsizing them)
- Heating/cooling and ventilation loads reduction combined with a high efficiency system with low efficiency equipment beats a low efficiency system with high efficiency equipment every time